Ref. No. Ex/PG/IlluTD/T/121A/2024

M.TECH. ILLUMINATION TECH.& DESIGN EXAMINATION
1st year, 2nd Semester 2024

SUBJECT: -Lighting Economics, Audit & Management

Full Marks 100
(50 marks for each part) **Time: Three (03) hours**

Instructions: Students have to answer ANY FIVE (05) questions. Each question carries 10 marks. To-the-point answer and neatness will be appreciated. Each question has several parts with distinct marking as given in the right side of the question. Use separate answer scripts for Part-I and Part-II.

<table>
<tr><th>Question Number</th><th>Part- I</th><th>Marks</th></tr>
<tr><td>1.</td><td>The auditors have proposed the following retrofitting solution for saving electricity bill in a school:
<table>
<tr><td>Functional area</td><td>Existing lighting scheme</td><td>Proposed lighting solution</td><td>Daily Operating Hour</td></tr>
<tr><td>Classrooms</td><td>200 Nos. 40W FTL lamps with 12% ballast loss each</td><td>200 Nos. 25W LED tubelight</td><td>10 Hour</td></tr>
<tr><td>Library</td><td>80 Nos. 25W CFL with 10% ballast loss each</td><td>80 Nos. of 18W LED downlight</td><td>12 Hour</td></tr>
<tr><td>Laboratory</td><td>160 Nos. of 32W FTL with 10% ballast loss each</td><td>140 Nos. of 20W LED T-lights</td><td>8 Hour</td></tr>
</table>
It is estimated that, replacing the existing luminaires with the proposed LED product will require a total initial investment of Rs. 7.5 lakh. If the electricity tariff is Rs. 6 per unit and the estimated project life is 8 years, calculate the (A) return-on-investment and (B) payback period.</td><td>5+5 =10</td></tr>
<tr><td>2.</td><td>Write a comprehensive abstract of the paper “LES: An Innovative Development for Lighting System Performance Evaluation” authored by Frey et al (1996) within 250 words.</td><td>10</td></tr>
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3.	The total length of an expressway is 200 km. This expressway is illuminated presently by conventional luminaires housing one 250W MH lamp each. The poles are placed in both sides of the road in opposite arrangement at equal gaps of 50 meter. The ballast loss occurring in each luminaire is 15%. Authority is now planning to replace all of these luminaires with 135W LED luminaires to save electricity bill. (A) Calculate the saving in electricity bill in a month and in a year if the average burning hour is 12 hours and the tariff is Rs. 6 per unit? (B) Calculate payback period if the cost of replacement per luminaire is Rs. 8000. (C) Considering project life of 8 years, calculate return on investment.	4+3+3 =10
4.	In a town of West Bengal, there are total 5 high-masts for outdoor lighting. Each high-mast comprises total 12 numbers of 1000W metal halide luminaires. The ballast loss of each such luminaire is 12%. To cut down monthly electricity bills, the town development authority has planned to replace each of the existing luminaires with 750W LEDs. For this replacement, the supplier has quoted an estimated cost of Rs. 20 Lakh. If the average daily burning hour is 10 Hours and the electricity tariff is Rs. 4 per kWh, Calculate: i. The payback period. ii. Return-on-investment assuming project life of 10 years and iii. Annual saving in electricity bill.	4+4+2 =10
5.	(A) Elaborate the steps of conducting lighting evaluation using LES. (B) What are the disadvantages of LES? In your opinion, how to mitigate them?	7+3 =10
6.	(A) Explain how fluctuation in supply voltage causes flicker in HID lamps. (B) With a circuit diagram, explain the principle of operation of active PFC employed in LED luminaires. (C) What are the problems caused by current harmonic injection by lighting loads?	3+4+3 =10
7.	(A) Describe the steps and tools involved in a manual lighting audit. (B) Write down the disadvantages of manual lighting audit.	7+3 =10